Fejervarya triora (Amphibia, Ranidae): first description of the adult male and recent distribution records

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We provide the first description of the adult male of *Fejervarya triora* Stuart, Chuaynkern, Chan-ard & Inger, 2006, based on a single specimen collected from Ubon Ratchathani Province, northeastern Thailand. Additional records of its distribution, based on voucher specimens, are given and a recent distribution map is provided. Our specimens represent new provincial records.

INTRODUCTION

The frog species *Fejervarya triora* was recently described from Ubon Ratchathani Province (type locality: "Phu Jong-Na Yoi National Park", Na Chaloey District, northeastern Thailand), based on a series of adult females and unsexed juvenile specimens (STUART et al., 2006). The holotype description was made from an adult female (FMNH 266172/THNHM 05325). Previously, even though CHAN-ARD (2003) provided a short description of the species in Thai as well as a life photo and a distribution map in his field guide, no information on male specimens was published. In general, local people from places surrounding the type locality are familiar with both sexes of this frog as they use it for consumption.

During a herpetological survey in 2005, we conducted field trips in several areas of Thailand. We thus obtained twenty-two specimens which we identified as *Fejervarya triora*. The frogs show external morphological characters similar to the original description given by STUART et al. (2006). This series of specimens included an adult male, which allows us to provide here the first description of an adult male of this species, accompanied by a recent distribution map.

MATERIAL AND METHODS

The specimens were caught in the field by hand, preserved in 10 % buffer formalin, and later transferred to 70 % ethanol. Before the specimens were fixed in formalin, tissue samples were taken by preserving pieces of liver in 95 % ethanol. The specimens in this study are catalogued and deposited in the collection of the Thailand Natural History Museum (THNHM), Pathum Thani, Thailand. The description format was based on the works of Ohler (e.g., OHLER, 1996; OHLER & DUBOIS, 1999; OHLER et al., 2000, 2002). Data concerning the type series of the species were obtained by YC. The criterion used for determination of the sex was the presence of vocal sac openings (HEYER, 2005). Webbing formula is given according to MYERS & DUELLMAN (1982). The illustration of nuptial pad morphology was made by CI using a Leica MS5 stereomicroscope with a camera lucida attachment, at the Laboratoire des Reptiles et Amphibiens, Muséum national d'Histoire naturelle (MNHN), Paris, France.

Measurements were made with digital calipers to the nearest 0.1 mm. Abbreviations used for measurements are:

SVL, snout vent length

Head: HW, head width, HL, head length (from back of mandible to tip of snout); MN, distance from back of mandible to nostril, MFE, distance from back of mandible to front of eye; MBE, distance from back of mandible to back of eye; IFE, distance between fronts of eyes, IBE, distance between backs of eyes, IN, internarial space, EN, distance from front of eye to nostril; EL, eye length, SN, distance from nostril to tip of snout, SL, distance from front of eye to tip of snout, TYD, greatest tympanum diameter; TYE, distance from tympanum to back of eye, IUE, minimum distance between upper eyelids, UEW, maximum width of inter upper eyelid

Forearm: HAL, hand length (from base of outer palmar tubercle to tip of third finger), FLL, forelimb length (from elbow to base of outer palmar tubercle), TFL, third finger length (from base of first subarticular tubercle), fd1-fd4, width of pads of fingers 1 to 4; fw1-fw4, width of fingers 1 to 4

Hindlimb: FL, femur length (from vent to knee), TL, tibia length, FOL, foot length (from base of inner metatarsal tubercle to tip of fourth toe), FTL, fourth toe length (from base of first subarticular tubercle); td1-td5, width of pads of toes 1 to 5, tw1 to tw5, width of toes 1 to 5, IMT, length of inner metatarsal tubercle; ITL, inner toe length.

Webbing: MTTF, distance from distal edge of metatarsal tubercle to maximum incurvation of web between third and fourth toe, TFTF, distance from maximum incurvation of web between third and fourth toe to tip of fourth toe, MTFF, distance from distal edge of metatarsal tubercle to maximum incurvation of web between fourth and fifth toe, FFTF, distance from maximum incurvation of web between fourth and fifth toe to tip of fourth toe, WTF, webbing between third and fourth toe (from base of first subarticular tubercle), WFF, webbing between fourth and fifth toe (from base of first subarticular tubercle), WI, webbing between third and fourth toe when folded along fourth toe (from base of first subarticular tubercle), WII, webbing between fourth and fifth toe when folded along fourth toe (from base of first subarticular tubercle).

RESULTS

Fejervarya triora Stuart, Chuaynkern, Chan-ard & Inger, 2006
(fig. 1-3)

Fejervarya sp.: CHAN-ARD, 2003. 110.
Fejervarya triora Stuart, Chuaynkern, Chan-ard & Inger, 2006: 11.

Material examined. THNHM 09052-65, four adult females and eight juveniles, collected by N. Salangsingha and S. Makchai between 14 and 21 September 2005 at Mukdahan National Park, Muang District, Mukdahan Province, Thailand; THNHM 09069-76, an adult male and an adult female, six juveniles, collected by N. Salangsingha and S. Makchai between 23 and 25 September 2005 at Pha Tam National Park, Khong Chiam District, Ubon Ratchathani Province, Thailand

Comparative material. – See STUART et al. (2006)

Description of male specimen THNHM 09074 (field number YC 0117), an adult male, Pha Tam National Park, Khong Chiam District, Ubon Ratchathani Province, northeastern Thailand. The specimen was collected by N. Salangsingha and S. Makchai on 25 September 2005. All measurements below are in millimetres.

(A) Size and general aspect. - (1) Frog of moderate size (SVL 45.3), body slender.

(B) Head. (2) Head of moderate size, about as broad as long (HW 17.7, HL 17.6; MN 15.5; MFE 12.5, MBE 7.3), flat above. (3) Snout obtusely pointed in dorsal view, rounded in lateral view, slightly projecting beyond lower jaw, its length (SL 7.4) longer than horizontal diameter of eye (EL 6.0). (4) Canthus rostralis rounded, loreal region obtuse in cross section. (5) Interorbital space flat, narrower (IUE 2.2) than upper eyelid (UEW 4.6) and than internarial distance (IN 3.4), distance between fronts of eyes (IFE 7.9) 1.6 times in distance between backs of eyes (IBE 12.4). (6) Nostrils rounded with flap of skin laterally, closer to tip of snout (NS 2.8) than to eye (EN 4.2). (7) Pupil not observed in this specimen. (8) Tympanum (TYD 4.1) distinct, rounded, 69 % of eye diameter; tympanum-eye distance (TYE 1.6) 39 % of tympanum diameter. (9) Pineal ocellus absent. (10) Vomerine ridge present, bearing few small teeth ($n = 4$), with an angle of 45° to body axis, less close to choanae than to each other, longer than distance between them. (11) Tongue large, oval, emarginated, bearing no median lingual process; tooth-like projections on lower jaw absent.

(C) Forelimbs. (12) Arm short, not very strong, fore-arm (FLL 9.5) as long as hand (HAL 9.5), not enlarged. (13) Fingers I, II and IV short and thin; finger III long and thin (TFL 5.6). (14) Relative length of fingers. II < IV < I < III. (15) Tips of fingers rounded, not enlarged, without grooves, narrow compared to finger width (fd1 0.9, fw1 0.9; fd2 0.9, fw2 1.0; fd3 0.7, fw3 0.9; fd4 0.7, fw4 0.9). (16) Dermal fringe on inner side of fingers II and III indistinct; webbing on fingers absent. (17) Subarticular tubercles strongly prominent, oval, single, all present. (18) Prepollex distinct, oval; palmar tubercles not separated into inner and outer metacarpal tubercles; no supernumerary tubercle

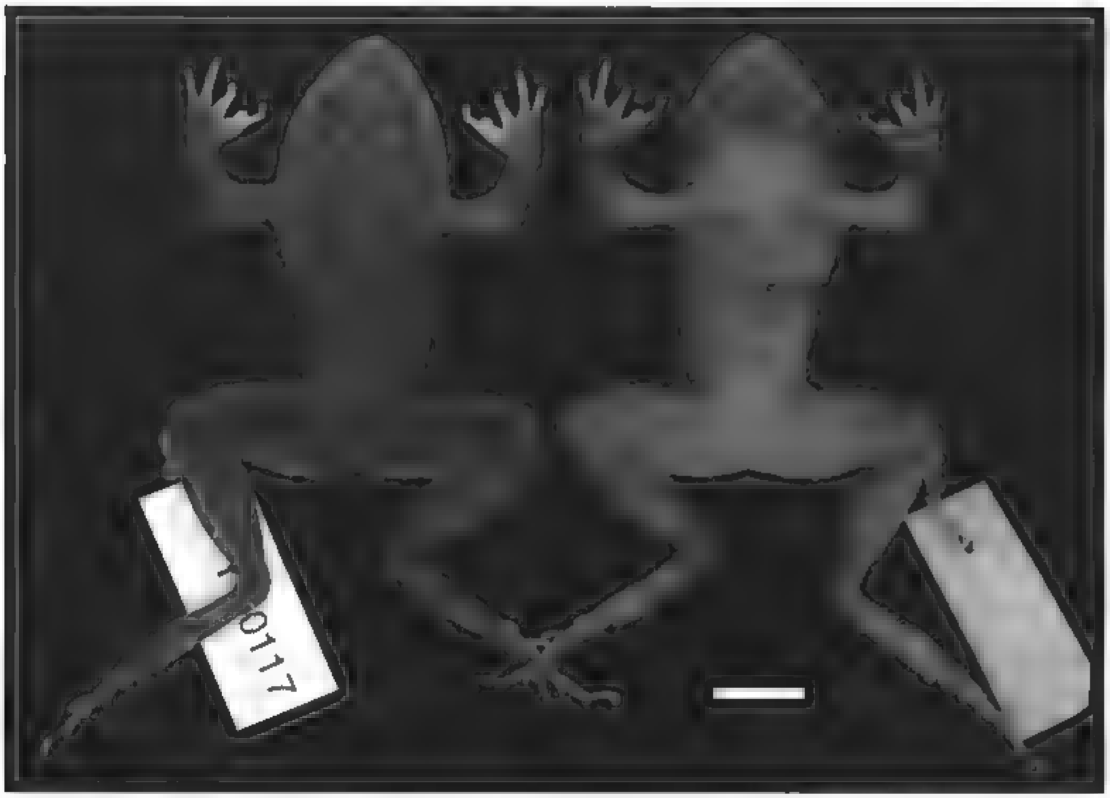


Fig 1 Adult male specimen of *Fejervarya triora* (THNHM 09074, SVL 45.3 mm.) Left, dorsal view, right, ventral view; scale bar, 10 mm

(D) Hind limbs. – (19) Hind limbs moderately long, heels overlapping when limbs are folded at right angles to body; tibia 3 3 times longer (TL 21 3) than wide (TW 6.6), longer than thigh (FL 20.7) and longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 21 0). (20) Toes long and thin, toe IV (FTL 12.3) longer than one third of distance from base of tarsus to tip of toe IV (TFOL 30.2). (21) Relative length of toes: I < II < V < III < IV (22) Tips of all toes rounded, not enlarged; disks absent on toes I-V, without grooves, narrow compared to toe width (td1 0 7, tw1 0.7; td2 0 6, tw2 0 7; td3 0.6, tw3 0.7; td4 0.7, tw4 0.7; td5 0.5, tw5 0.6) (23) Webbing present, rudimentary: I 1 $2^{1/3}$ II 1 $2^{1/3}$ III 1 3 IV 3 1 V (WTF 3.6, WFF 3.1; WI 3 7, WII 3 1; MTTF 9 5, MTFF 9.3, TFTF 8 4, FFTF 9.6). (24) Dermal ridge along toe V present from tip of toe to distal outer metatarsal tubercle, well developed. (25) Subarticular tubercles strongly prominent, oval, simple, all present. (26) Inner metatarsal tubercle distinct, elongated; its length (IMT 3.1) 1.4 times in length of toe I (ITL 4 2) (27) Tarsal fold absent. (28) Outer metatarsal tubercle present, rounded, supernumerary tubercles and tarsal tubercle absent.

(E) Skin. (29) Snout and skin between eyes smooth, side of head smooth with few horny spinules on the area of upper lip. Anterior part of back smooth, posterior part shagreened with horny spinules. Upper part of flank, from line from insertion of arm to groin, granular with horny spinules, lower part of flank granular. (30) Dorso-lateral folds absent; supratympanic folds present and strong, from posterior edge of eyelids to shoulders, parotoid glands

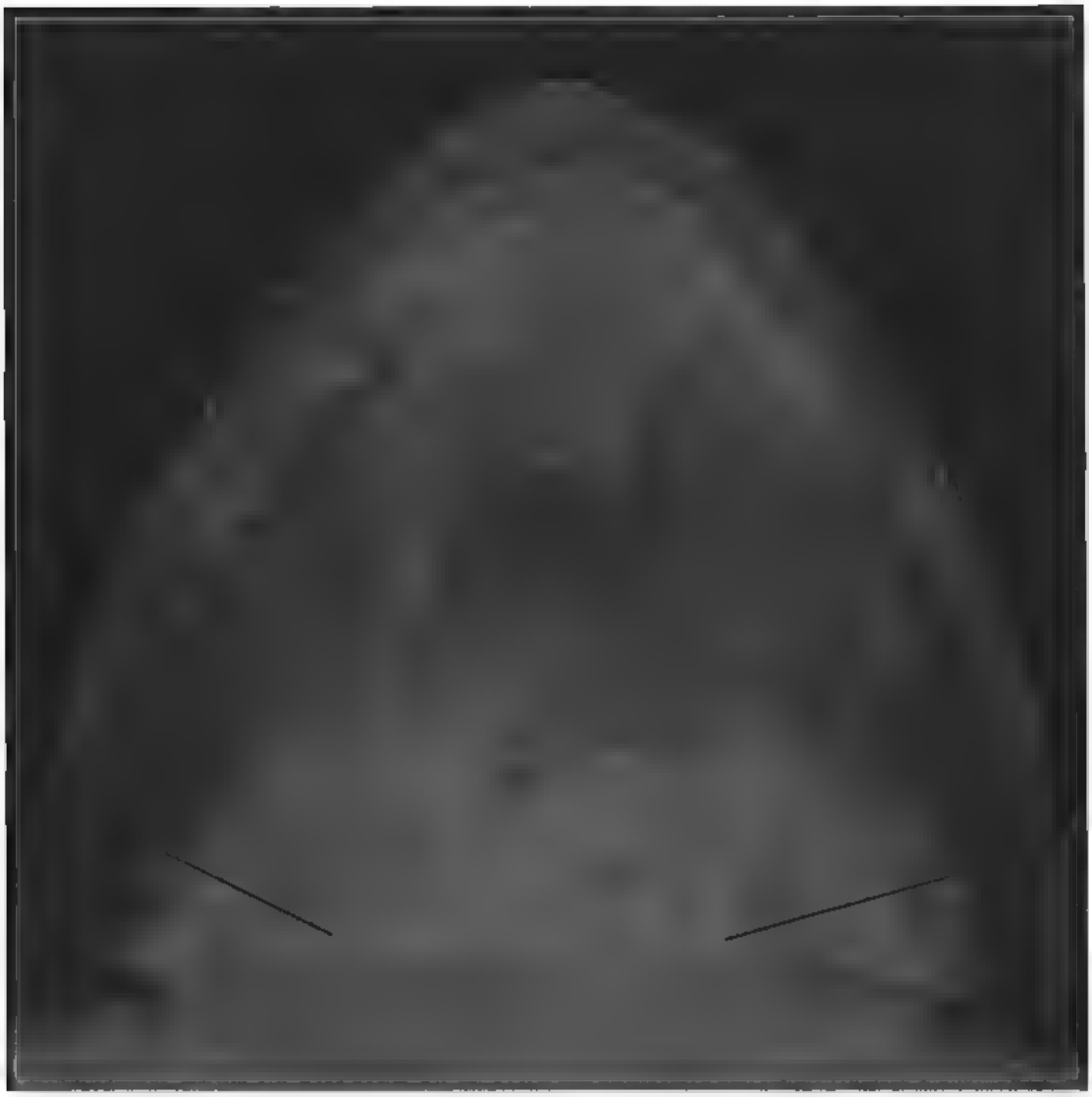


Fig. 2. – The external vocal sac (wrinkled skin pointed to by arrow) of male *Fejervarya triora* (THNHM 09074).

absent; cephalic ridges absent; co-ossified skin absent; Fejervaryan line indistinct. (31) Dorsal parts of forelimb, leg and tarsus smooth with few horny spinules; dorsal part of thigh with feeble glandular folds bearing few horny spinules. (32) Throat, chest, belly and anterior ventral part of thighs smooth; posterior ventral part of thigh with tree-frog belly skin. (33) Macroglands absent.

(F) Coloration (in alcohol). – (34) Dorsal parts of head and dorsum dark grey with dark brown marbling, "V" shape band extending from edge of eyelid to each other; flank dark brown with light marbling; loreal region and tympanic region dark grey; upper lip dark grey with four feeble dark brown bands. (35) Dorsal parts of forelimb dark grey with dark brown crossbars on forearm, dorsal parts of thigh, leg and foot dark grey with black crossbars;

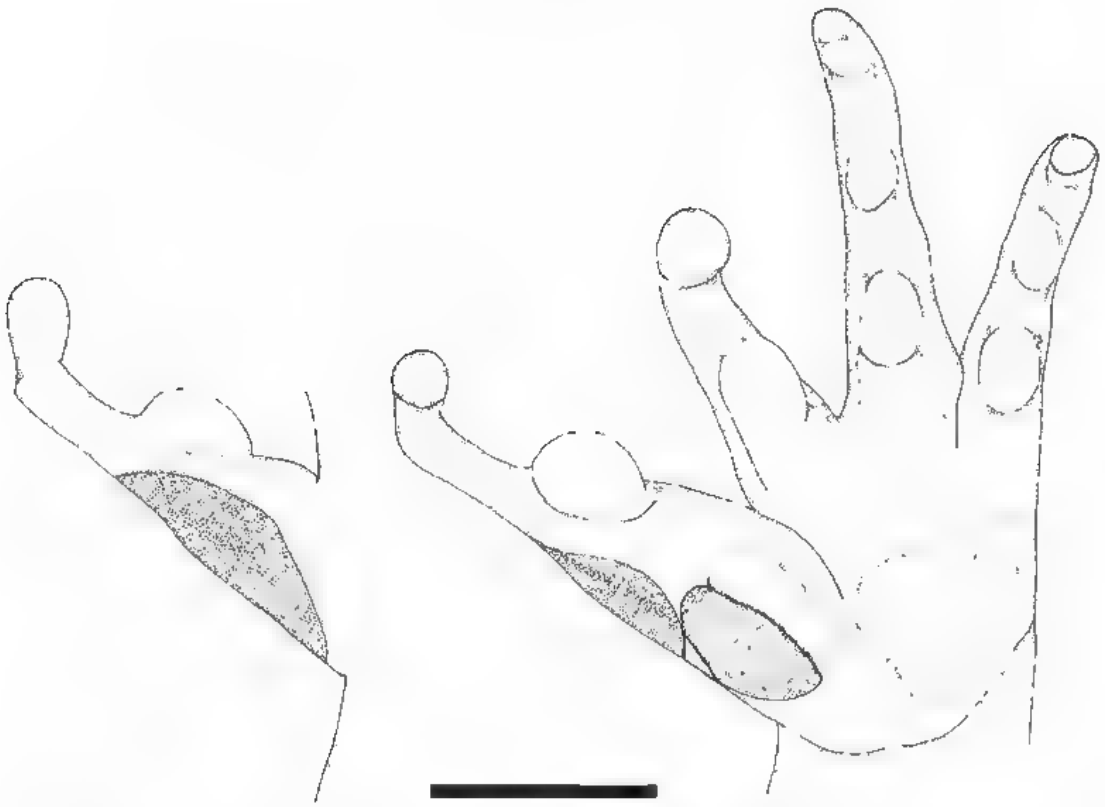


Fig. 3 Hand of male *Fejervarya triora* (THNHM 09074) showing nuptial spines on first finger in dorsal (left, drawn from right hand) and dorsolateral (right, drawn from left hand) views. Scale bar, 30 mm

posterior part of thigh dark brown with light vermiculations. (36) Throat and its margin dark mottled on approximately 2/3 of throat; vocal sacs with dark mottling (fig 1-2); chest and belly greyish white with more mottling in the area of breast and lateral sides of belly; webbing brown.

(G) Male secondary sexual characters (37) Two pads in contact, oval shaped nuptial pad on finger I, with small, translucent spines (fig 3) (38) Vocal sacs present, distinct on throat as wrinkled skin beside corners of jaws (fig. 1-2); paired openings of vocal sacs distinct, slit-like, at anterior corner of jaw (39) Other secondary sexual characters absent.

Natural history notes. Frogs were collected at night starting at 19h00 in deciduous forest. At Mukdahan National Park, the substrate where the frogs were found is very large igneous rock with several small hollows (containing water only in the rainy season), whereas at Pha Tam National Park it is sandstone bedrock where erosion formed several small temporary hollows. The frogs were found sitting on the ground, on dead leaves, grass, or sitting in the hollows. From the observation of NS and SM, only the juvenile frogs (tentatively so defined by their small size) were found in daytime but never adult frogs (tentatively so defined by their larger size) Adult frogs could be observed when the sun went down. Individuals of very large size were found more frequently at night when it did not rain, whereas adult male frogs (large size but smaller than females and calling) were mostly found during rainy nights.

Tab 1 – Selective measurements in millimetres (mean ± standard deviation, and min-max) of adult *Fejervarya triora* from Phu Jong-Na Yoi National Park (10 adult females, holotype and paratypes), Mukdahan National Park (4 adult females) and Pha Tam National Park (an adult female and an adult male). Measurements are defined in the *Material and methods*. Some measurements of the type series are not available, indicated as n.a., because of use of different measurement methods by YC in 2005.

	Phu Jong - Na Yoi	Mukdahan	Pha Tam			Phu Jong - Na Yoi	Mukdahan	Pha Tam	
	females	females	female	male		females	females	female	male
SVL	58.2 ± 1.7 (55.5-60.8)	57.5 ± 2.4 (55.1-60.3)	55.6	45.3	FLL	14.1 ± 0.6 (13-15.1)	13.4 ± 0.9 (12.4-14.1)	13.3	9.5
HW	24.2 ± 1.3 (22.8-27.2)	22.3 ± 1 (20.8-23.1)	21.9	17.7	TFL	6.8 ± 0.3 (6.3-7.3)	7.2 ± 0.3 (7-7.7)	6.9	5.6
HL	21.1 ± 0.6 (20.22.1)	22.2 ± 1 (21.2-23.2)	22.5	17.6	FL	28.5 ± 0.9 (27.8-30.3)	25.5 ± 1.1 (24.6-26.9)	25.6	20.7
MN	n.a	19.2 ± 1 (18.3-20.3)	19.6	15.5	TL	30.2 ± 1 (29-32.1)	28.3 ± 0.8 (27.7-29.4)	26.4	21.3
MFE	n.a	14.4 ± 0.8 (13.5-15.2)	14.5	12.5	FOL	29.4 ± 1 (27.5-31.1)	27.9 ± 0.8 (26.9-28.8)	26.7	21
MBE	n.a.	8.8 ± 0.7 (8.1-9.7)	9.4	7.3	FTL	16.8 ± 0.6 (15.7-17.8)	16 ± 0.3 (15.8-16.4)	15.3	12.3
IFE	n.a.	9.3 ± 0.4 (9.1-9.8)	9.3	7.9	IMT	3.8 ± 0.2 (3.7-4.1)	3.8 ± 0.3 (3.5-4.1	3.5	3.13
IBE	n.a.	14.8 ± 0.6 (14.1-15.5)	13.8	12.4	ITL	6.3 ± 0.3 (5.5-6.6)	6.2 ± 0.1 (6.1-6.3)	6.2	4.2
IN	4.4 ± 0.3 (4-4.8)	4.7 ± 0.2 (4.4-4.9)	4.3	3.4	TW	9.9 ± 0.8 (8.3-11.1)	9 ± 0.9 (8.1 10.3)	7.9	6.6
EN	5 ± 0.3 (4.4-5.5)	5.6 ± 0.2 (5.3-5.8)	5.3	4.2	TFOL	41.3 ± 1 (39.9-43)	40 ± 0.5 (39.4-40.4)	38.5	30.2
EL	6.7 ± 0.2 (6.5-7)	6.5 ± 0.2 (6.3-6.8)	6.5	6	MTTH	n.a	13.4 ± 0.2 (13.2-13.5)	12.6	9.5
NS	n.a.	4.1 ± 0.4 (3.7-4.6)	3.3	2.8	MTFF	n.a.	13.2 ± 0.3 (12.8-13.5)	12.9	9.3
SL	9 ± 0.4 (8.3-9.4)	9.2 ± 0.4 (8.8-9.8)	8.6	7.4	TFTF	n.a.	10.4 ± 0.7 (9.4-11.1)	11.1	8.4
TYD	4.8 ± 0.2 (4.3-5)	4.4 ± 0.3 (4.1-4.7)	4.4	4.1	FFTF	n.a.	11.7 ± 0.2 (11.5-11.9)	11.2	9.6
TYF	1.5 ± 0.3 (1.2-1.9)	1.7 ± 0.2 (1.5-1.8)	1.7	1.6	WTF	n.a.	6 ± 0.9 (5.1-7.1)	5	3.6
IUE	n.a.	3.2 ± 0.3 (2.8.3.5)	3.3	2.2	WFF	n.a.	5.2 ± 0.4 (4.7-5.8)	4.8	3.1
ELW	n.a	5.6 ± 0.6 (5-6.2)	5	4.7	W1	n.a	5.2 ± 0.5 (4.9-6)	5.2	3.7
HAL	12 ± 0.4 (11.5-12.7)	12.1 ± 0.4 (11.7-12.7)	11.9	9.5	W2	n.a	4.2 ± 0.8 (3.3-5.3)	4.6	3.1

Comparisons Our single male specimen has morphological characters that agree with the females described by STUART et al. (2006) in having a very broad head and a broad supratympanic fold obscuring the dorso-posterior margin of tympanum. Yet, this specimen differs from these females in its smaller size (SVL 45.3 mm, vs. 55.5-60.8 mm in 10 adult females, average 58.2 ± 1.7). This appears to be sex dimorphism in size, known in other

species of *Fejervarya* (Dubois & Ohler, 2000; Veith et al., 2001). The pineal ocellus, visible in the female specimens studied by Stuart et al. (2006), is absent in our male specimen, so this character shows intraspecific variation. The male specimen observed exhibits two palmar tubercles in contact (not separated into inner and outer metacarpal tubercles), as mentioned in the description of Stuart et al. (2006). The difference might be due to preserving preparation. The skin on top of the head in our male specimen seems to be smooth, versus shagreened in the specimens described by Stuart et al. (2006). This also might be caused by different conservation conditions. According to Stuart et al. (2006), the type series and other specimens they examined are in good condition whereas our specimens are rather slightly stiff. Due to the poor condition of our specimen, we could not observe the flap of skin on the preaxial side of fingers II and III which were described by Stuart et al. (2006) in their females. Adult female specimens from Mukdahan and Pha Tam national parks show dorsum pattern (in preservative) variable in amount of blotches or spots, as noted by Stuart et al. (2006). Measurements data show that the adult females from those three localities are in the same range (tab. 1). More specimens, especially adult males, are further required to test sexual dimorphism in this species. Nevertheless, we consider that the differences observed result either from sex dimorphism or from fixation and conservation conditions, and we assign this frog to *Fejervarya triora*.

Distribution. Thailand: Ubon Ratchathani , Na Chaloey District, Phu Jong-Na Yoi National Park (Stuart et al., 2006), Khong Chiam District, Pha Tam National Park (this study), Mukdahan Province, Muang District, Mukdahan National Park (this study).

Prior to this study, *Fejervarya triora* had only been known from the type locality. Our specimens represent the first provincial record for Mukdahan Province and also an additional provincial record for Ubon Ratchathani Province. The distribution map of this species is shown in fig. 4. The species *Fejervarya triora* is currently known only from Thailand, but might be expected in Laos.

Discussion

Recently, Frost et al. (2006) proposed a new taxonomy for living amphibians based on combined anatomical and molecular data. The family Ranidae Rafinesque-Schmaltz, 1814 was partitioned into eleven families to avoid paraphyly with regard to the families Rhacophoridae and Mantellidae. Among them, the Dicroglossinae (sensu Dubois, 1992, 2005) were elevated to family status. The genus *Fejervarya* Bolkay, 1915 was referred to this family. In this paper we adopt a conservative attitude in using the family Ranidae in the traditional sense (Dubois, 1992, 2005, Bossuyt et al., 2006; Ohler & Dubois, 2006). Within this frame, the genus *Fejervarya* is a member of the subfamily Dicroglossinae Anderson, 1871.

As a result of this study, the male of *Fejervarya triora* is shown to have secondary sex characters similar to those indicated by Dubois et al. (2001), who gave diagnostic morphological characters of nine genera of the subfamilies Dicroglossinae and Raninae of the family Ranidae. For the genus *Fejervarya* Bolkay, 1915, they described the vocal sac in males as "Marked by darker coloration, and sometimes also by longitudinal folds, on sides of throat",

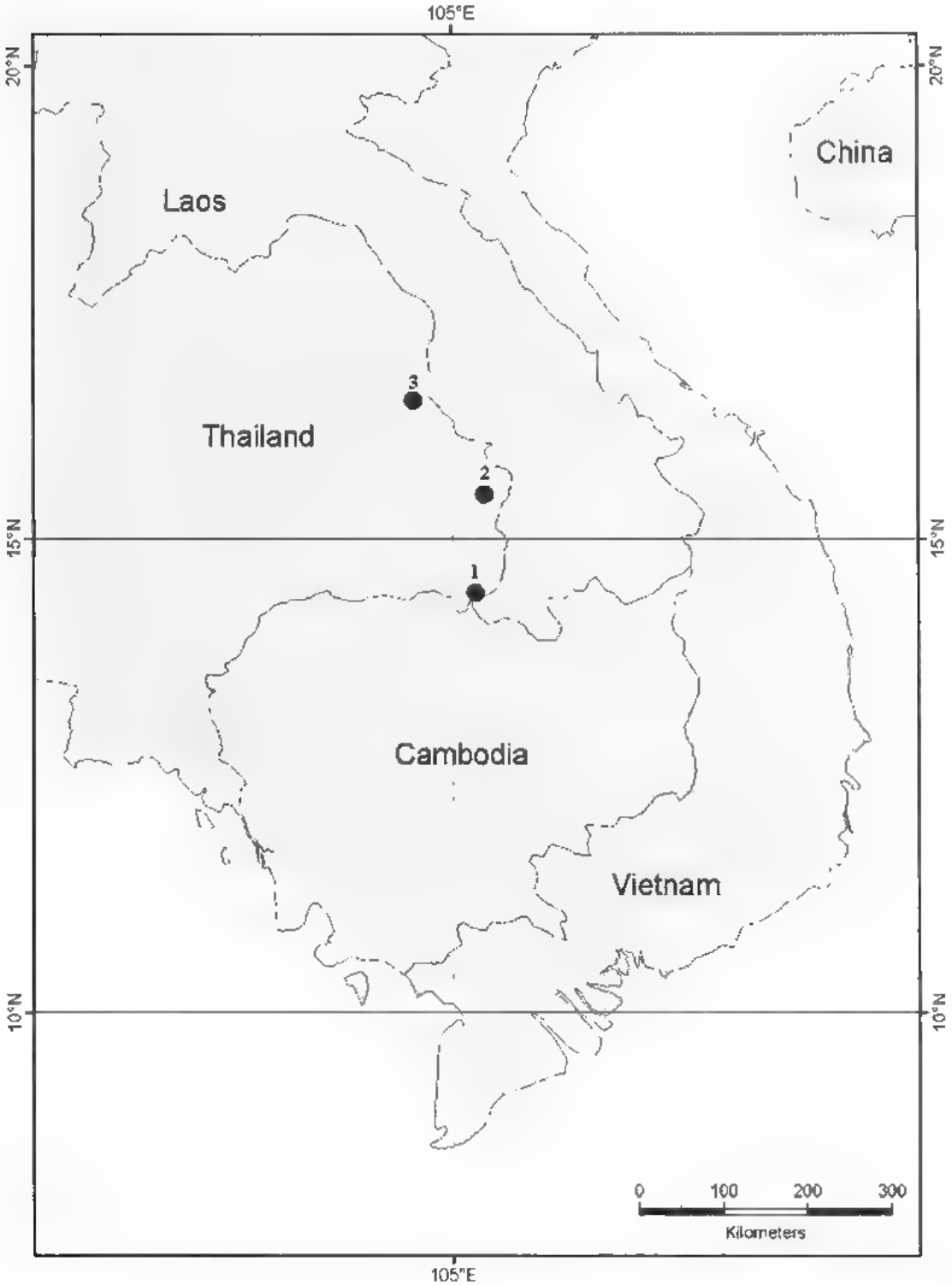
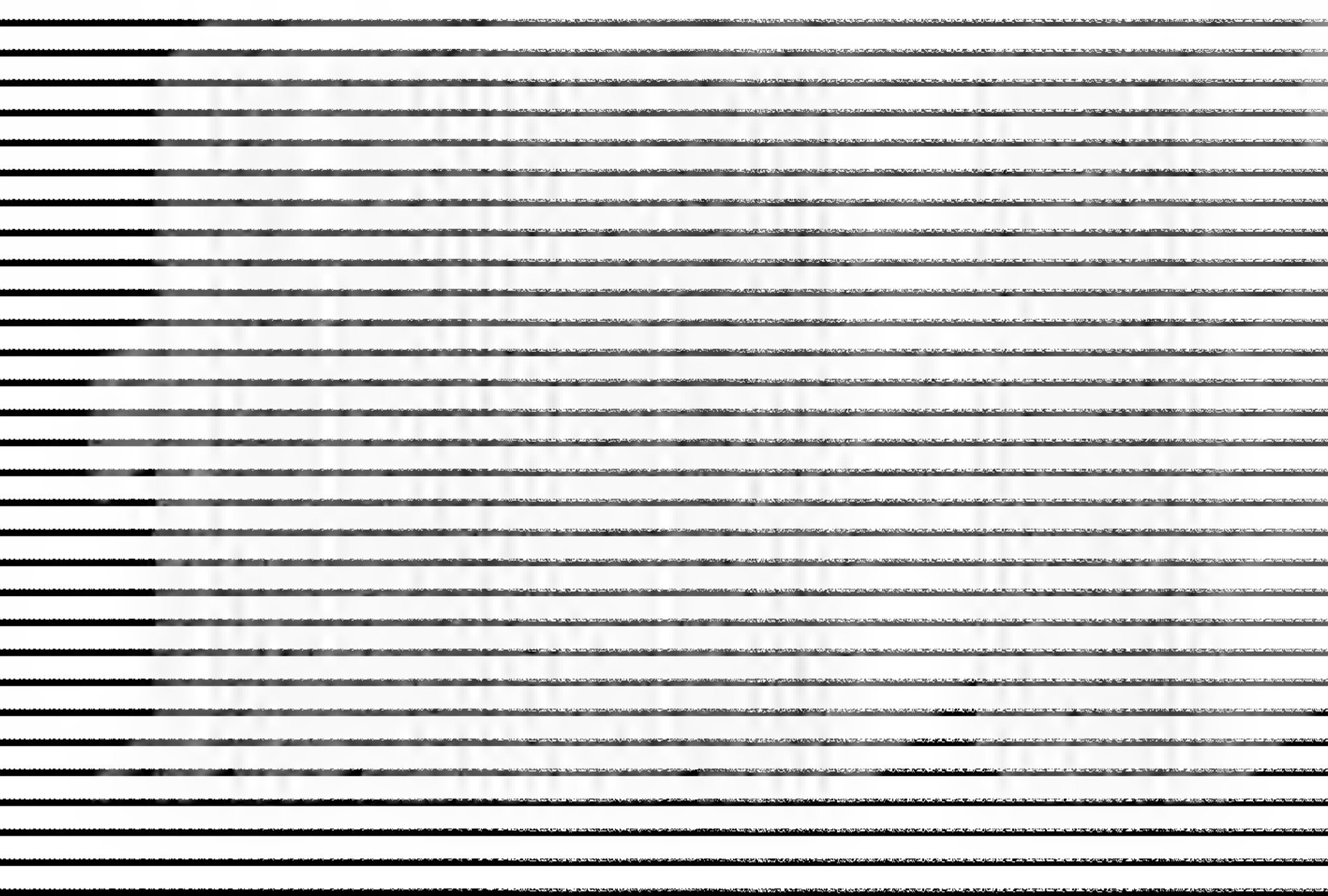


Fig. 4. Map of the Indochinese peninsula showing localities of distribution of *Fejervarya triora* reported in this study and in STUART et al. (2006). 1, Phu Jong-Na Yoi National Park (type locality), Na Chaloey District, Ubon Ratchathani Province; 2, Pha Tam National Park, Khong Chiam District, Ubon Ratchathani Province; 3, Mukdahan National Park, Muang District, Mukdahan Province.



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